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NEW ZEALAND

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COMPLETE SPECIFICATION

Non-toxic Vegetation Control

We, *Waipuna Systems Limited*, a New Zealand company, of 7th Floor, Downtown House, QEII Square, 21-29 Queen Street, Auckland, New Zealand, do hereby declare the invention for which I/we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement :

- 1 -

The invention comprises a method and apparatus for killing or controlling weeds.

Conventionally weed growth is controlled either by use of herbicide chemicals which are applied to the weeds by spraying or in the form of powder or granules which are sprinkled about the weeds, or alternatively by physically uprooting the weeds. Physically removing the weeds is time consuming and labour intensive. Herbicides can be relatively expensive, and there is increasing resistance to the use of such synthetic chemicals in the environment.

The present invention provides an alternative method and apparatus for killing or controlling weeds.

A method of killing or controlling weeds, comprising applying to the weeds pressurised hot water or hot water and steam at a temperature of substantially 75°C or above, by spraying over the foliage of the weeds, in which the hot water or hot water and steam is delivered to an outlet therefor at a pressure in the range of 200 p.s.i to 1000 p.s.i, and containing the hot water or hot water and steam to an area about the outlet.

Preferably the steam or hot water is at a temperature of substantially 90°C or above and most preferably at a temperature in the range of 90°C to 110°C.

Apparatus for killing or controlling weeds comprising means for heating water for application to weeds to a temperature of substantially 75°C or above, means for applying the steam or hot water through an outlet at a pressure in the range 200 p.s.i to 1000 p.s.i to weeds by spraying over the weed foliage, and a shroud about said outlet, said shroud extending towards the ground.



Preferably the apparatus comprises means arranged to maintain an outlet from which the steam or hot water is sprayed at a substantially constant spacing above the ground. Alternatively, the apparatus could comprise distance sensing means such as an electronic height indicator coupled to some form of mechanical spacer to maintain the outlet at a substantially constant spacing above the ground.

Preferably the apparatus also comprises a shroud about the outlet and extending towards the ground, to contain the steam about the outlet and about the weeds being treated.

In one form the applicator is a hand held applicator for applying the steam or hot water to weeds which is movable manually by an operator treating an area for weed control. The applicator may be connected by a flexible hose to a steam generation/hot water unit as will be described.

In another form for treating larger areas of ground in a single pass, the applicator head may comprise a boom to be towed behind or otherwise conveyed by a vehicle over the ground, having a number of spray outlets along the length of the boom. The boom may have wheels or skids, or other ground sensing means, associated with the boom for maintaining the boom and spray outlets at a substantially constant spacing above the ground.

The invention will be further described with reference to the accompanying drawings, by way of example and without intending to be limiting. In the drawings:

Figure 1 shows a van mounting apparatus of the invention including both a manual hand held applicator and a towed boom applicator,

Figure 2 shows a preferred form of manual hand held applicator or the invention,

Figure 3 is a three quarter view from below of the head of the applicator of Figure 2,

Figure 4 is a view from immediately below of the head of the applicator of Figure 2,

Figure 5 is a view of the towed boom applicator from behind with parts removed, and

Figure 6 is a close up view of one outlet of the boom applicator of Figure 5.

Figure 1 shows apparatus of the invention mounted to a van, within the van are mounted a water tank 1, a boiler 2 arranged to heat smaller volumes of water supplied by the water tank to the desired temperature, a pump 4, and a pump motor 3. The boiler 2 and pump motor 3 are powered from the battery of the van, or alternatively a separate generator with its own prime move such as a small petrol motor could also be provided within the van to generate power for the pump motor and boiler. The pump 4 supplies

the steam or hot water generated by the boiler 2 to the hand held applicator 5 and the towed boom applicator 6 over flexible hoses 7. Any other water heating or steam generation plant could be employed. For example instead of a boiler, a water heater of the instant flow through type could be used.

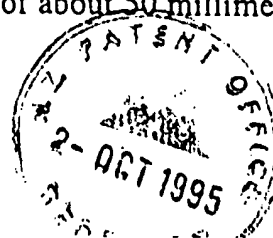
The hand held applicator 5 and boom applicator 6 will be described in further detail but each provide an outlet for spraying the steam or hot water over weeds.

75°C has been found to be a practical lower limit for hot water application to weeds to substantially limit regrowth. Temperatures in excess of 90°C and most preferably in the range 90°C to 110°C are preferred. At this temperature the spray from the outlet tends to be a mixture of steam and large droplets of hot water, as opposed to fine mist spray. It is also wet, as opposed to dry superheated steam generated at higher temperatures. This wet steam and hot water droplets mixture has been found most effective in spreading over the foliage and killing it and in reducing the strength of the weeds so that they tend to go limp or collapse to the ground. Also, hot water and wet steam in this temperature range have been found to have an effective root penetration effect so that the hot water/steam tends to penetrate into the ground about the weed roots and kill the root system of the weeds, to further enlarge the time until weed regrowth. Preferably water is delivered whether in the form of hot water or steam or a mixture, at a rate in the range 200 to 1000 litres per hour.

Figures 2 to 4 show the preferred form hand held applicator 5. It comprises a shaft 8

and handle 9, and preferably a trigger 10 whereby the operator may turn the spray of steam/hot water on and off. The applicator is connected to the flexible hose 7 which may for example pass down inside the interior of the handle 8 to a nozzle 11 as an outlet at the base of the shaft 8, as shown in Figure 4. The nozzle 11 acts to deliver the hot water and steam as a spray. A shroud 12 suitably shaped as shown is provided about the nozzle 11 to contain the steam about the area beneath the applicator being treated at any instant as the applicator is moved over the ground, and to prevent dissipation of the steam by wind for example. The shroud may suitably be formed of metal or plastics or any other suitable material. It is preferred but not essential to employ some form of shroud. In the applicator shown in the drawings the front and rear edges of the shroud are enlarged at 12a so that they can move easily over weed foliage. Any other suitable arrangement of shroud could be employed.

To maintain the nozzle 11 at a substantially constant spacing above the ground, the applicator comprises wheels 13. The wheels 13 are fixed to the shroud 12 or to some other frame at the base of the shaft 8 which also carries the shroud 12, and are so positioned that the nozzle 11 is positioned at the desired height above the ground. It has been found most desirable that the outlet is positioned at not more than 100 millimeters within the ground for most effective operation. The spacing depends on the volume flow rate and pressure of flow through the nozzle selected and by easy experimentation the optimum or effective height may be found. In the preferred form applicator head with a hot water/steam temperature of about 100°C and a water consumption/flow rate of 100 litres per hour, an outlet spacing from the ground of about 50 millimetres has



been found to be most effective. Preferably the spray is delivered at a pressure of between 400 and 100 psi, for best effect.

In use, an operator moves the applicator over the ground by rolling it along on the wheels 13, operating the trigger 10 to spray hot water and steam onto weeds over which he rolls the applicator. The wheels 13 ensure that the spray is applied to weeds from the constant height.

Alternatively to the shells 13 a single wheel, or one or more skids could be employed, for example. various other configurations of manually, hand held applicator will be apparent from that described. It is also possible that to enhance penetration to the root system of the weeds, the applicator could include one or more wheels with spikes or tines, for example mounted within the shroud 12, to penetrate the soil surface.

Figure 5 shows the preferred form of towed boom applicator 6 from behind. The boom applicator comprises a frame 14 having a draw bar 14a (see Figure 1). The frame 14 forms a boom carrying a spray pipe 15 extending along the length of the boom as shown. The spray pipe 15 is connected to the hose 7 from the high pressure pump via piper 16. At either end of the frame/boom are provided ground wheels 17 which maintain a constant spacing between the boom and the ground as the boom passes over the ground. A subsidiary wheel 18 may be provided as shown.

A number of outlets 19 are provided from the spray pipe 15, with one preferred

arrangement being shown in Figure 6. Each outlet 19 comprises a short length of flexible hose 20 connected to the spray pipe and mounting a nozzle 21 at its lower end. In use hot water or steam passes through the spray pipe 15 down through the short flexible hose 20 and is ejected from the spray nozzle 21 over the ground over which the boom moves. The advantage of the flexible mounting arrangement is that each nozzle can deflect when hitting taller weeds or other obstructions. A shroud 22 formed of for example, rubber or plastic flaps or even a rigid shroud, may be provided on either side of the boom to shroud the spray outlets 19 along the boom and contain the spray for maximum effect. Any other suitable shroud arrangement could however be employed. In Figure 5 the shroud is shown partly removed so that the outlets 19 along part of the boom can be seen.

One or both sides of the boom may be pivotally mounted. In Figure 5, one side of the boom is pivotally mounted at 23 so that it can pivot upwardly, as that side of the boom passes over a slope, or be pivoted upwardly by cylinder 24 to reduce the width of the boom applicator for towing when not in use, as is known for other types of agricultural equipment comprising a boom for applying herbicides or fertilizers etc.

Again, it will be clearly apparent that a boom applicator for applying hot water or steam in accordance with the invention could be otherwise arranged. For example, the boom applicator could be mounted to the front of a tractor instead of being towed. The boom could form part of a purpose built vehicle. For example, a purpose built vehicle could instead of employing a boom have a number of spray outlets on its underside between



wheels at four corners of the vehicle with shrouds about the sides of the vehicle towards the ground, to spray weeds as the vehicle is driven over them. Again in the case of a handheld applicator the water supply and water heater could be mounted to a frame to form a back pack unit, powered over a long extension cord from a mains supply or a mobile generator or battery. All such variations and modifications as will be apparent are intended to be incorporated within the scope of the invention, as defined in the following claims.

The following table shows results from one test using the method and apparatus in accordance with the invention, as compared to the commonly employed herbicide glyphosate.

Application Conditions with Invention

Application temperature:	100°C
Application rate: (water consumption)	750 litres per hour
Application pressure:	500 psi
Outlet nozzle height from ground:	50mm
Weed types:	Annual and established perennial

Table

<u>Condition</u>	<u>Invention</u> (time from appln)	<u>Glyphosate</u> (time from appln)
Wilting & discolouring	Immediate	10 days
Complete brown off	4 days	25 days
Visible regrowth	60 days	60 days
Regrowth cover 50%	85 days	85 days
Regrowth cover 95%	100 days	100 days

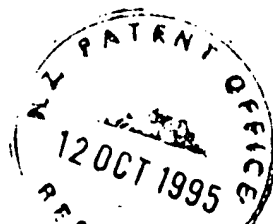
With the method and apparatus of the invention, weeds may be controlled without the use of synthetic herbicides and thus in a completely environmentally friendly way. The method and apparatus of the invention have found to be surprisingly effective achieving kill time in which weeds are brown and clearly dead after application in the range of a few days, as opposed to one to three weeks for commonly employed herbicides. Also, the cost of synthetic herbicides is avoided.

WHAT WE CLAIM IS:

1. A method of killing or controlling weeds, comprising applying to the weeds pressurised hot water or hot water and steam at a temperature of substantially 75°C or above, by spraying over the foliage of the weeds, in which the hot water or hot water and steam is delivered to an outlet therefor at a pressure in the range of 200 p.s.i to 1000 p.s.i, and containing the hot water or hot water and steam to an area about the outlet.
2. A method as claimed in claim 1, wherein the spray is delivered to said outlet at a pressure in the range 400 to 1000 p.s.i.
3. A method as claimed in claim 1 or 2 comprising applying to the weeds hot water or hot water and steam at a temperature of substantially 90°C or above.
4. A method as claimed in claim 3, comprising applying to the weeds hot water or hot water and steam at a temperature in the range 90°C to 110°C.
5. A method as claimed in any one of the preceding claims, wherein the spray comprises a mixture of hot water droplets and wet steam.
6. A method as claimed in any one of the preceding claims, wherein the hot water or hot water and steam is applied through the outlet from which the hot water or hot water and steam is sprayed, positioned not more than 100 millimetres from the ground.



7. A method as claimed in any one of the preceding claims, wherein the temperature is sufficiently high to kill the weeds.
8. A method as claimed in any one of the preceding claims, wherein the hot water or hot water and steam penetrates to kill the root system of the weeds.
9. A method of killing or controlling weeds, substantially as described herein and as shown in the accompanying drawings.
10. Apparatus for killing or controlling weeds comprising means for heating water for application to weeds to a temperature of substantially 75°C or above, means for applying the steam or hot water through an outlet at a pressure in the range 200 p.s.i to 1000 p.s.i to weeds by spraying over the weed foliage, and a shroud about said outlet, said shroud extending towards the ground.
11. Apparatus as claimed in claim 10, comprising means arranged to maintain an outlet from which the steam or hot water is sprayed at a substantially constant spacing above the ground.
12. Apparatus as claimed in claim 10, comprising means arranged to maintain an outlet from which the steam or hot water is sprayed at a substantially constant spacing from the ground by a ground contacting part adjacent the outlet with the ground.



13. Apparatus as claimed in claim 12, wherein the ground contacting part comprises wheel(s) or skid(s) in fixed position relative to the outlet to contact the ground and maintain an outlet at a substantially constant height above the ground.

14. Apparatus as claimed in either one of claims 12 and 13, wherein the outlet and ground spacing means form part of an applicator head of a hand held applicator for applying the steam or hot water to weeds, movable manually by an operator in treating an area for weed control.

15. Apparatus as claimed in any either one of claims 12 and 13, wherein the outlet and ground spacing means form part of an applicator head comprising a boom to be conveyed by a vehicle over ground and comprising a number of said outlets along the length of the boom.

16. Apparatus as claimed in any one of claims 10 to 15, comprising a water tank and heating means for heating water prior to spraying, mounted on a vehicle for mobility, and a pipe connecting the heating means to the outlet.

17. Apparatus as claimed in claim 16, wherein the water supply and heating means are mounted for mobility to a vehicle or trailer or trolley.

18. Apparatus as claimed in any one of claims 10 to 17, arranged to apply the steam or hot water at a temperature of substantially 90°C or above.

19. Apparatus as claimed in any one of claims 10 to 17, arranged to apply the steam or hot water at a temperature in the range 95°C to 110°C.
20. Apparatus as claimed in any one of claims 10 to 19 arranged to deliver the spray as a mixture of hot water droplets and wet steam.
21. Apparatus as claimed in any one of claims 10 to 20 arranged to deliver the spray to said outlet at a pressure in the range of 400 to 1000 psi.
22. Apparatus for killing or controlling the growth of weeds substantially as herein described with reference to the accompanying drawings.

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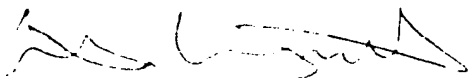


FIG.1

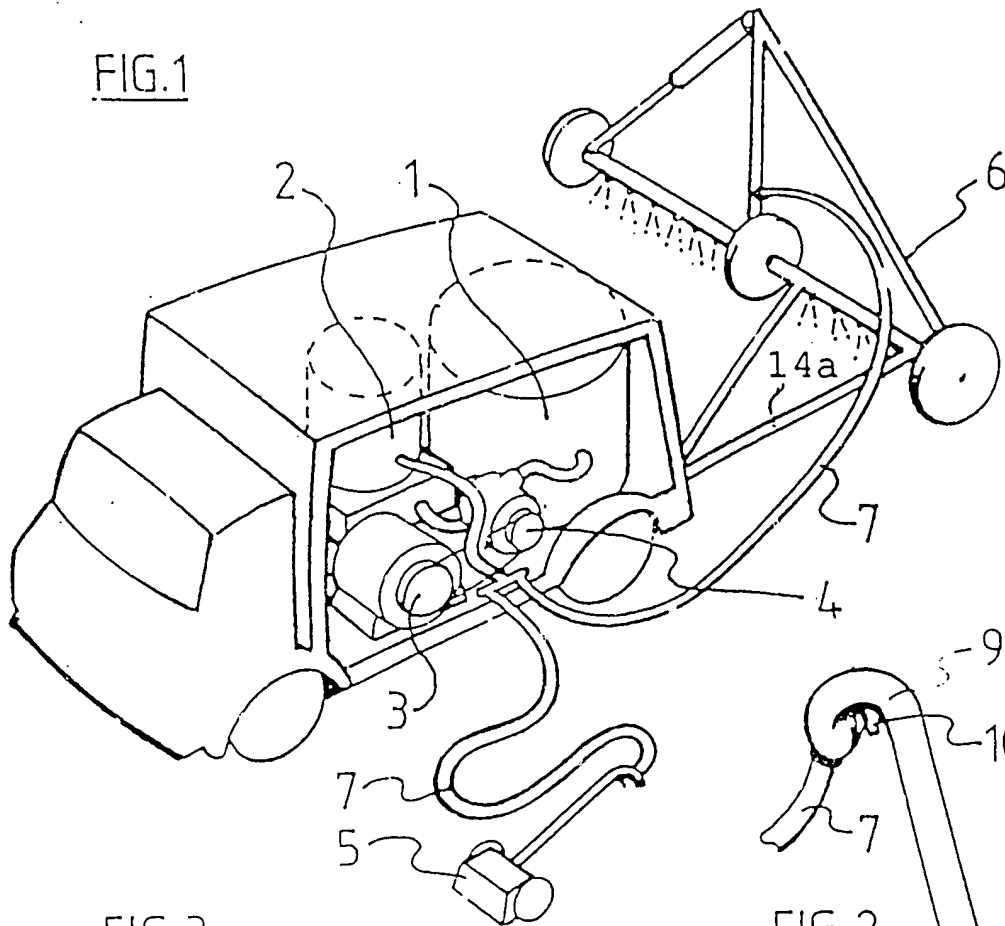


FIG.3

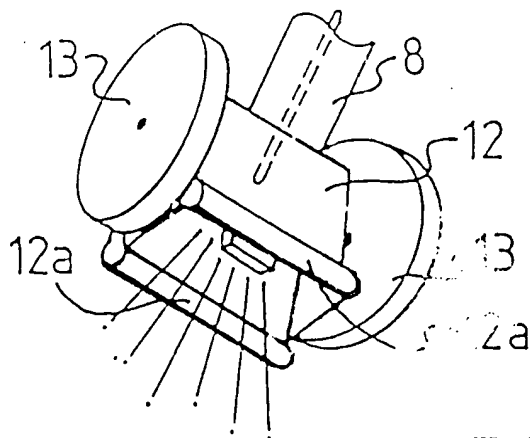


FIG.2

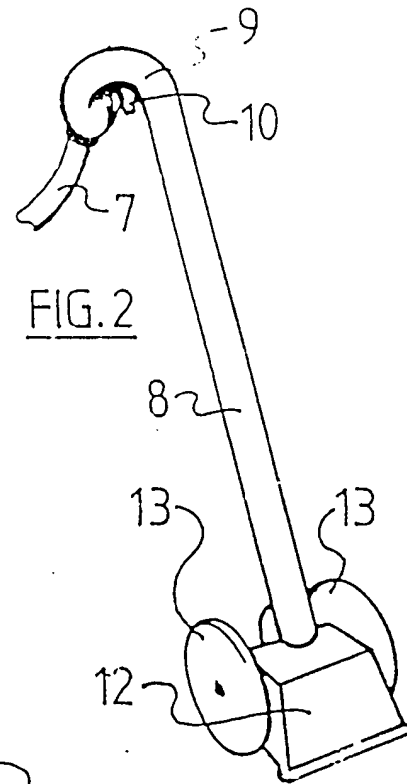
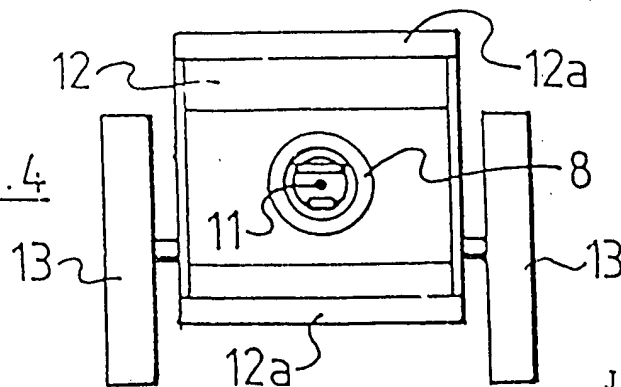


FIG.4



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FIG. 5

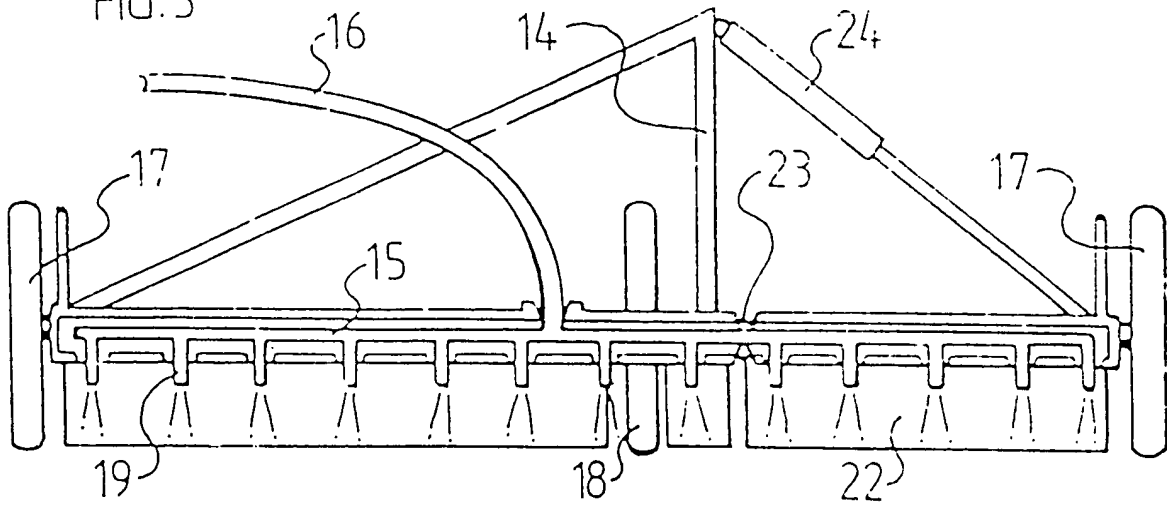
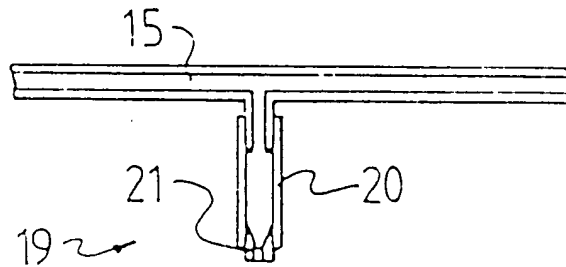


FIG. 6



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